AEC-NASA TECH BRIEF

Study of Convective Magnetohydrodynamic Channel Flow

A study has been made of the effects of the interactions of electromagnetic, velocity, and temperature fields to aid in the design of a magnetohydrodynamic device, such as a magnetohydrodynamic power generator. Previously, considerable analytical effort had been extended to understand the velocity and electromagnetic interactions; however, little has been done with thermal interactions. The results are presented in a report, *A Study of Convective Magnetohydrodynamic Channel Flow,* by Ralph M. Singer, ANL-6967, Argonne National Laboratory, Argonne, Illinois.

The study concerns a theoretical analysis of the convective flow of an electrically conducting gas in a channel composed of conducting walls. The analyses are restricted to cases of fully developed laminar flow in vertical rectangular channels. The report adds to the knowledge of magnetohydrodynamics and provides an insight into the problem of combining the effects of fluid flow and electromagnetic forces.

The steady, combined, free and forced convective flow of an electrically conducting fluid through a vertical channel in the presence of a horizontal magnetic field is studied. Three distinct physical situations are investigated: (a) parallel-plate channel with walls of arbitrary electrical conductivity, (b) rectangular channel containing a fluid with a very small magnetic Prandtl number, and (c) rectangular channel with nonconducting walls.

Basic information on the interaction of mechanical, thermal, and electromagnetic forces is presented. In addition, it has been found that a magnetic field strongly inhibits free convection, and a criterion is established indicating when free convection may or may not be neglected. It has also been noted that a magnetic field sufficiently flattens the velocity profile in a channel so that the flow can be considered one dimensional in many cases.

Notes:

1. The work presented in this report is a continuation of that presented in ANL-6937 which considers the unsteady, convective, magnetohydrodynamic flow in a parallel-plate channel. Both reports are available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151 for $3.00 each, (microfiche copies, $0.65 each).
2. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B68-10181

   Source: R. M. Singer
   Reactor Engineering Division
   (ARG-10102)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

Mr. George H. Lee, Chief
Chicago Patent Group
U.S. Atomic Energy Commission
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Category 02